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ENTIALS FOR FLOOD REDUCTION IN

MURRY CANYON

APRIL 1970

JOINT STUDY

BY

FOREST SERVICE ——— AND ——— BUREAU OF LAND MANAGEMENT

POTENTIALS FOR FLOOD REDUCTION

IN

MURRY CANYON

ELY NEVADA

FEBRUARY 1970

Joint Study

By

Forest Service and Bureau of Land Management

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POTENTIALS FOR FLOOD REDUCTION IN 1/

MURRY CANYON

ABSTRACT

A hydrologic investigation was conducted on the Murry Canyon drainage system during October of 1969. The purpose and scope of this report is to discuss some of the most promising treatments for reducing high intensity storm related floods for each catchment in Murry Canyon. The results of the investigation show that land treatment potential in the watershed is limited due to the poor potential for permanent vegetative recovery and because of the storm type and frequency. The installation of channel drop-structures and excavated basins of one to three acre feet should improve channel storage and ground water recharge. These measures should be beneficial in reducing many flood peaks because the total volume of water in the floods is generally less than 50 acre feet per square mile. Structures, such as that used in Ice Plant Canyon, cannot be effectively used in the other drainages due to the steeper channel gradient. This system of basins will not eliminate flood problems due to inadequate storm drain capacity in the city and modifications which are needed at the water works. Part of the problem can be solved by providing zoning of remaining undeveloped land in Murry Canyon and by selecting and designing selected city streets to act as floodways.

Key Words: Murry Canyon; Ely, Nevada; Floods; Cloudburst; Murray Canyon; Robinson Watershed; White Pine County

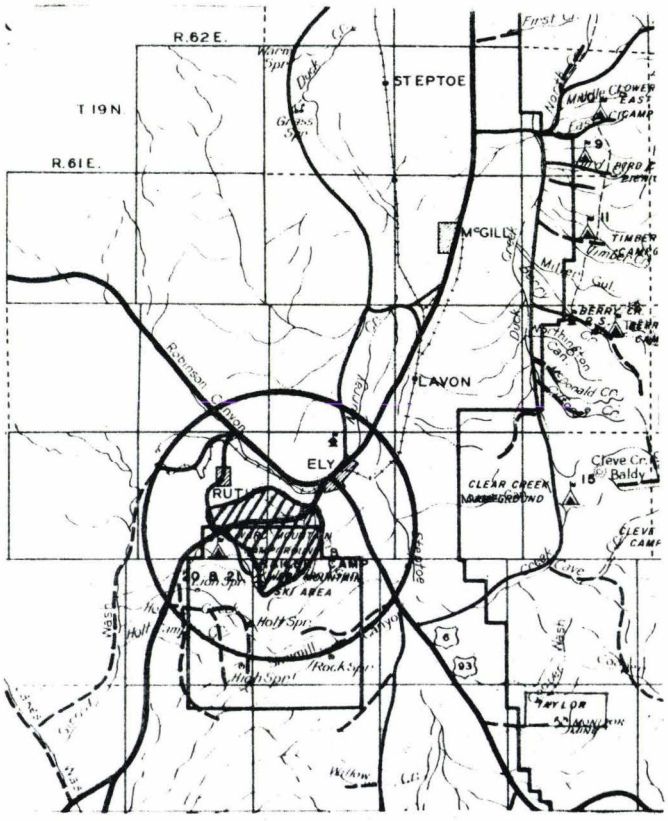
INTRODUCTION

Murry Canyon is a 16-square mile drainage lying southwest of Ely, Nevada. The center of the watershed lies at approximately latitude 39° 13' north and longitude 114° 56' west. It drains into Steptoe Valley, a closed basin within the Great Basin. The western watershed boundary separates the Great Basin and the Colorado River drainage. It ranges in elevation from 6500 to 9400 feet and limestone geology dominates the watershed. Pinyon-juniper and various brush species are the dominant vegetation.

The canyon is affected, periodically, by cloudbursts, which cause flooding in Ely. The canyon is also the source of culinary water for the city of Ely.

This report explores potential treatment possibilities to reduce floods in Ely and prevent contamination of the water supply.

1/ Report written by Larry Schmidt, Hydrologist, U.S. Forest Service, with the aid of John Trimmer, Civil Engineer, Bureau of Land Management.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T.19N.
R.61E.
STEPTOE
McGILL
RUTH
ELY
CLEAR CREEK
Cleve Cr.
Baldy
Holt Spr.
Rock Spr.
High Spr.
Robinson Canyon
Duck Creek
Warm Spr.
First Sp.
Hendrys Creek
Mill Creek
Berry Cr.
Timber Camp
Cleve Creek
Taylor
Mountain
Ski Area
Campground
Santa Rosa Div.
Humboldt Div.
Paradise Valley
Winnemucca
Ruby Div.
Schell Div.
Snake Div.
White Pine Div.
Reno
Carson City
Las Vegas
NEVADA
KEY MAP

Key Map

Conclusions

1. Murry Canyon is frequented by flood producing summer storms on the average of once in seven to 10 years. It is estimated that the majority of these floods last less than four hours and contain a total volume of water generally less than 50 acre feet per square mile.

2. Storms located in the lower canyon area immediately above the Murry Spring are more damaging than those located in the upper basins. Instantaneous peaks of 400 to 600 cubic feet per second per square mile can be produced in these storms which generally occur sometime between mid-July and the first of September. Because of the low volume and short duration of these storms, channel storage coupled with percolation can be very effective in reducing peak flows. Some of this effectiveness has been reduced by construction of highly efficient channels adjacent to the highway. These channels are generally shorter, steeper, and have a clearly defined cross-section; resulting in more rapid transportation of water and less reduction of peak flows.

3. Onsite land treatments, such as contour trenching, are limited by rainfall, growing season, surface-soil movement, and shallow depth to bedrock. Treatments which can be accomplished should be beneficial in reducing the flood peaks; however, due to storm type and magnitude, and the limited treatment potential, no positive flood prevention can be assured. The storm drain capacity of 35 cfs is inadequate to pass even small localized floods in the Murry Canyon area within the city limits.

4. The erosion process is complex, consisting, in part, of frost related solifluction to a depth of approximately four to six inches. This soil slowly migrates downslope toward the drainage bottoms. The loose surface material and that deposited in the drainages is moved periodically by storms which produce surface runoff. This erosion takes the form of miniature mudrock flows, two to four feet wide and six inches deep. These flows leave dikes and deposit material at any change of slope or obstruction. These factors indicate a high viscosity for these flows. Thus, most erosion moves a short distance and restabilizes temporarily.

5. Murry Spring flows in limestone cavities and may have a source outside Murry Canyon which could provide pollution from surface runoff. Sediment pollution from Murry Canyon can be prevented by raising collection boxes and protecting them with mounded earth and/or by a low dike which would protect the springs from flood flows and surface runoff and/or by providing sealed headbox lids and seals around vent pipes. Garbage dumped above the spring may be providing biological pollution.

6. The ten-year grazing rest has been beneficial in improving ground cover in the higher elevation westerly portion of the watershed near Ward Mountain.

7. Estimates based on Corps of Engineers damage estimates show that approximately $4,000 of annual damage might be expected and that a project with a 50-year life has a present value of $79,000 in reducing damages in Ely City, (based on January 1970 dollars and an interest rate of 4.5 percent). This is about $5,000 per square mile or $8.00 per acre.

These figures do not include onsite benefits to land, water yield benefits, pollution reduction at spring, or benefits from preventing loss of life.

8. Estimates are that the present channel storage reduces peaks by about 12 percent on the average. Additional reductions with treatment by contour trenching and by channel storage improvement measures might account for approximately 10 to 90 percent additional reduction in peak flows depending on which of the subdrainages are contributing to the flow. (See Appendix G, page 56, for details.)

RECOMMENDATIONS

1. An evaluation of treatment feasibility determined that approximately 100 channel drop structures of various sizes and approximately 25 excavated basins for one to three acre feet capacity should be installed. Approximately 1250 acres should be contour trenched and seeded on the south slope of the main canyon. Contour furrowing should be done on 350 acres in upper Right-Angle Canyon. Both the contour trenching and furrowing will require pinyon-juniper removal. Road erosion and runoff need to be controlled on 15 miles of primitive roads. In addition, culvert energy dissipation structures are needed in several areas. Also some ripping and seeding would be beneficial in certain portions of the upper alluvial basins.

2. A dam which would regulate approximately six to ten acre feet should be located above the spring area on city property. A small regulation structure should be located in the vicinity of the old Kennecott pumphouse below the spring as a means of regulating the flow into the storm drain.

3. Flood plain zoning should be provided by the city of Ely, especially for undeveloped lands or abandoned lands in the Murry Canyon drainage to prevent obstruction or restriction of flow and to provide for building code regulations which will provide the maximum protection against floods.

4. A public education program should be developed to train residents of Murry Canyon in the use of flood proofing measures. Some simple measures, such as building sills around basement windows and installation of sealed flood doors which can be quickly placed in main entrances in time of floods are described in brochures published by the Center for Urban Studies, Chicago, Illinois, and others. (28) These practices would help to minimize damages.

5. Murry Street should be designated as a floodway and channels and protective dikes should be constructed in Murry Canyon above Murry Street. A construction and maintenance program should be developed to eliminate the crown in the pavement and reshape the street to convey water in excess of storm drain capacity. In addition, a no-parking provision from 9 a.m. to 12 p.m. during July and August and making Murry Street a one-way north, for wintertime safety, would be beneficial in providing for passage of water with a minimum of damage to property.

6. The dumping of garbage and other contaminates in Elderberry Canyon and other canyons above Murry Spring should not be permitted and the chlorination system should be repaired or replaced with new equipment to insure continuous protection against biological pollution.

7. All surface water intercepting basins in the spring enclosure should be closed off and an engineering review of the spring collection system should be made to determine the need for cutoff valves and to detect other possible problems.

8. The spring collection boxes should be raised approximately 10 feet and an earth mound placed around the box or a protective dike should be constructed to protect the collection boxes from surface runoff. No grass cutting within the spring enclosure should be permitted as this protective cover is valuable in reducing and retarding flood flows.

Methodology

An initial two-day reconnaissance evaluation was conducted to determine the survey objectives, size of the drainage, access possibilities, the sources of information, and to develop a general feel for the problem.

After crews from the Bureau of Land Management and Forest Service were briefed on objectives and procedures, they were split into three-man crews to begin classifying areas according to the way they disposed of rainfall and runoff, and their potential for onsite treatment.

Such items as soil texture and depth, vegetative type, ground cover density, slope, observed erosion, and any additional ecologic or geomorphic factors which might aid in developing a treatment proposal were evaluated.

The most critical basins were outlined on a map and triangular design hydrographs were created for various storms taken from Weather Bureau TP-40 for the Murry Canyon area. These figures are felt to be quite conservative based on The Nevada Watershed Studies in progress by the Bureau of Land Management. The two studies nearest Murry Canyon are the Duckwater watershed to the west and the Steptoe watershed to the south.

All other pertinent climatic, geologic, historic, and ecologic information was evaluated to determine some of the other key factors affecting the hydrologic function of the watershed. Channel storage and losses were assumed constant per unit length of channel and were used in conjunction with a one-hour 100-year storm on the catchments to determine an approximate priority for treatments. The specific design, planning, and priorities will have to be determined in developing the final action treatment plan.

The information included in this report is the best currently available, considering the lack of basic climatic and hydrologic data for the area. It should be modified and changed as any new information becomes available for the area.

ENVIRONMENTAL FUNCTIONS AND RELATIONSHIPS

The environment in Murry Canyon is the key to understanding the phenomena which influence damaging runoff and erosion. This understanding is essential in providing sound treatments to reduce the damages caused by infrequent cloudburst floods.

The relationships affecting the normal hydrologic function and the hydrologic function under stress will be discussed in two separate sections.

Normal Hydrologic Function.

Under normal conditions the Murry Canyon drainage complex has no active streams. The only live water comes from Murry Spring which rises about two miles above the confluence with Gleason Creek in the city of Ely.

The spring apparently flows in solution cavities in limestone. These cavities probably follow lines of weakness related to faulting associated with earthquakes. The evidence of stream piracy in the upper drainage and low rainfall tend to indicate that the sources of water for Murry Spring might lie outside of the Murry Creek drainage. Limestone springs, such as this, are generally more subject to various types of pollution, because of the minimal filtration properties associated with underground rivers.

The well-distributed precipitation throughout the year amounts to approximately nine inches at the mouth of Murry Canyon and 30 inches at the highest elevations. This precipitation is generally absorbed by the loam soils before it accrues in amounts sufficient to produce runoff. This, generally, is the case, in spite of the fact that the ground cover density is low over the watershed.

The closed communities of pinyon have created large areas which have no cover other than erosion or frost-related stone pavement. This has revealed some of the erosional processes more clearly.

Frost action or solifluction appears to be one of the dominant soil movement processes. Diagnostics for this process appear over most of the watershed below the 8,000-foot level. Evidence of surface-soil creep into drainage bottoms can be observed in many places. Frost related miniature patterned ground, approximately on a five-inch spacing, was observed on a flat ridge.(31)

In addition, many stone stripes were observed which are the result of freeze-thaw cycles on slopes. These stripes, at first, give the impression of rill erosion.

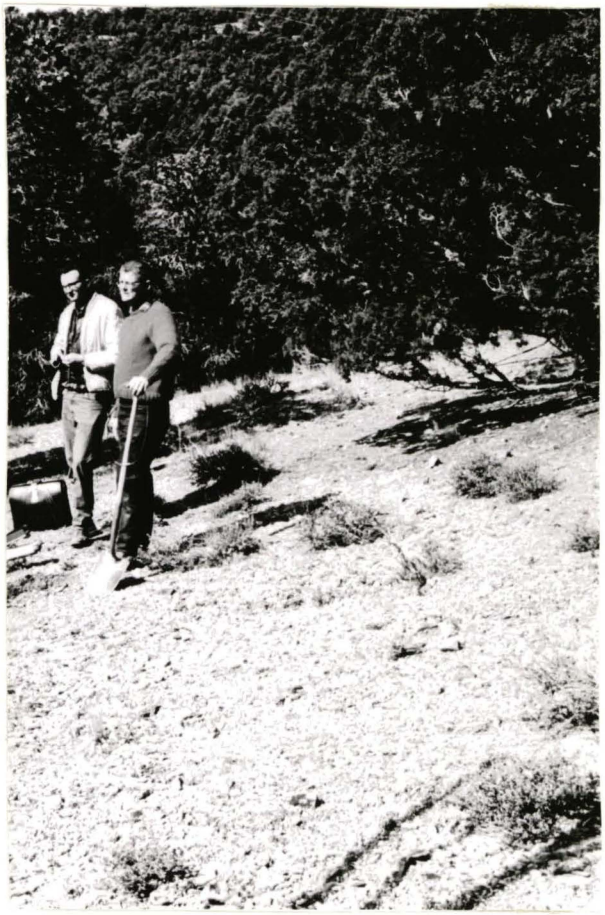

Photo No. 1 Typical ground cover in a closed stand of pinyon and juniper. Note the dominance of angular stone fragments on the surface. These provide some protection against raindrop splash erosion. This is typical of approximately 70 percent of the watershed.

Photo No. 2 A view of very distinct frost related miniature patterned ground. These serve as a definite diagnostic for solifluction processes. These processes are accentuated on shallow soils.

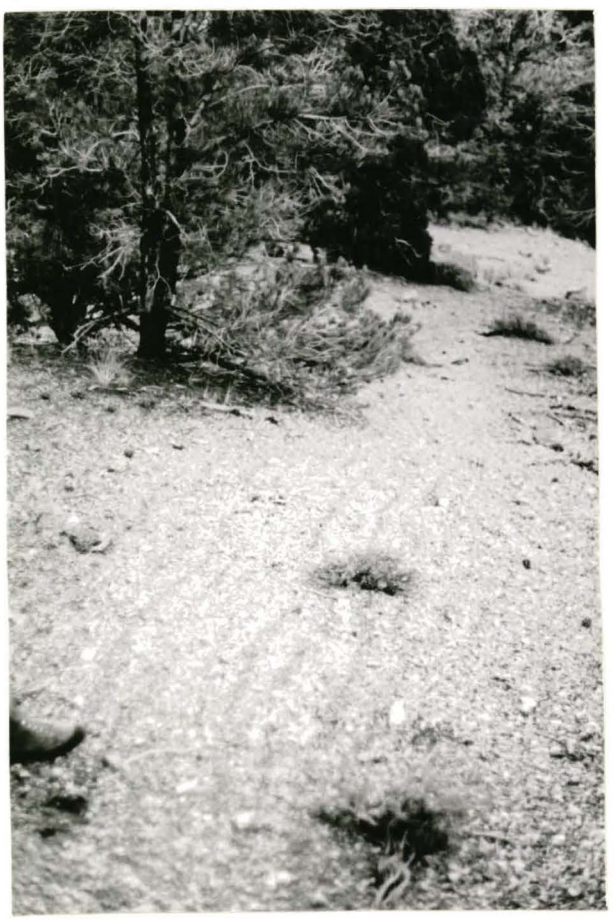

Photo No. 3 Typical miniature stone stripe patterns observed on slopes. Looking downslope. Note that micro-climatic effects related to vegetation cause them to be discontinuous.

The uniform width of the stripes and the concentration of stones in the shallow depressions tend to indicate that erosion by surface water is only a minor factor in the development of these features.

These phenomena tend to indicate that trench maintenance might be a particular problem in the pinyon-juniper zone unless trees are completely removed. This is because of a suspected strong relationship between the lack of insulating snow cover and the long-wave radiation transmitted by these trees. The removal of trees should result in a more continuous snow cover which should insulate the ground, inhibiting frost action. Additionally, there could be problems in establishing protective vegetation in the form of grasses which are not frost resistant.

At the higher elevations there is some invasion of juniper, followed by pinyon into sage-grass flats. Without control this succession will, probably, result in closed communities of pinyon and juniper and expose more soil to frost action and erosion at the higher elevations. (3)

Photo No. 4 Area showing some of the invasion by juniper into sage-grass area north of Murry Summit. Juniper is apparently the first species to invade, followed by pinyon. Older stands are dominated by pinyon. (3)

This encroachment is probably related to periods of overgrazing, climatic change and control of wild fire. There may be some benefit to selective removal or chaining of pinyon and juniper at elevations above 7,800 feet where the soil is deep enough to support a good sage-grass cover and the precipitation is adequate to establish a grass cover.

Hydrologic Function Under Stress.

The most important stress received on the Murry Canyon Watershed is from high intensity, short duration summer rain storms. These storms may be relatively small in area, sometimes as small as one or two square miles in area, and tend to have the greatest probability of occurrence in July and August. The small size and short duration of these storms cause the water to concentrate rapidly into the channels and results in very high instantaneous rates of runoff for a short distance downstream. These rates may equal or exceed those for snow-melt floods from Gleason Creek, but because of the small volume of water involved, their rates of runoff are generally reduced rapidly by channel storage. A storm located at high elevations generally will have less effect because of the long channel length and better vegetative cover. An equal-sized storm located near Ely will be more potentially damaging because of the close proximity and shorter channel length in which flows may be dissipated.

In reviewing weather records it appears that small storms generally occur before the flood producing rains. These small storms increase soil-moisture content and reduce infiltration rates; thereby increasing runoff from any subsequent storm.

Stone pavement is the most important soil protecting agent in the watershed. It tends to reduce puddling and detachment of the soil from intense rainfall. This pavement is not as effective as good litter or vegetative cover, which is sparse in the pinyon-juniper types.

Water caused erosion is effectively active only during these intense storms and during occasional snowmelt floods. It is characterized in many cases by miniature mud flows which are two to four feet wide and four inches to a foot in depth on the slope. Slope erosion, such as this, occurred in the July 1968 flood. This erosion, generally, takes place on narrow strips, (three feet wide), and is active to a depth of five inches.

The characteristics of this flow closely approximate those of the much larger mudrock flows of Utah. When the antecedent soil moisture conditions are wet and a high intensity storm follows, the following characteristics may be observed:

1. A flow channel scoured to a depth of five inches and approximately two feet to three feet wide occurs.

2. The depth is restricted by a stone content in excess of 40 percent at a mean depth of five inches.

3. Small boundary dikes of eroded material are formed the length of these channels, indicating the highly viscous nature of these flows.

4. At any obstruction or break in slope, which reduces the energy of the flow, large percentages of the sediment, particularly coarse fragments, are deposited. This phenomena was observed over most of the watershed. At these inflection points in energy, the larger material is the first to be deposited. Other material may remain suspended as long as there is sufficient water to transport it. For this reason, most sediment is made up of suspended load derived primarily from raindrop-splash erosion.

Photo No. 5 Note the depositional dikes in the middle foreground indicating the viscous nature of the flowing material.

Photo No. 6 Typical debris deposit at the base of the slope.

Photo No. 7 Evidence of raindrop-splash erosion takes the form of pedestaled stones, such as this. This tends to indicate the intense nature of storms.

Channel erosion appears more limited than hill-slope erosion, except that in general, there is more transportable material and a greater concentration of water to transport it. Many of the drainage bottoms also differ, in that they have a rather dense cover of sage and grass, which retards erosion and tends to cause further deposition.

The increased rock content at a depth of five inches on the slopes, in combination with poorly defined ephemeral channels with low energy gradients and high-roughness coefficients in the drainages, account for the lack of major gully systems. These bottoms also have relatively high recharge rates and can accept water into subsurface storage rapidly, if this water is detained. The runoff is generally carrying sediment in excess of its normal competence and therefore, cannot erode the channel. There are, however, some discontinuous gullies in alluvial bottoms which will probably become continuous if treatments are not undertaken. (19)

Photo No. 8 Headcut portion of discontinuous gully in alluvial plain above Murry Spring.

Walnut Gulch Watershed in Arizona is also characterized by ephemeral channels and high intensity storms. Although the topography is somewhat different, the flood characteristics give some indication of how the Murry Canyon channels might perform under flood conditions. A 3.2 square-mile watershed produced an instantaneous peak of 4400 cubic feet per second. It had a time to peak of about 25 minutes and reduced to approximately 100 cubic feet per second in 30 more minutes. This 100 cubic feet per second tapered to no flow in approximately one and one-half hours more. The total flood event lasted only two and one-half hours.

The total volume of water involved was only 159 acre feet. Channel transmission loss rates in the ephemeral channel were between 10 and 12 acre feet per mile of channel. (21) The transmission loss rates for Murry Canyon would be less because the channel is more confined and the water has less surface on which to infiltrate.

The Walnut Gulch area is much closer to the Gulf of Mexico and hence, receives more moisture than does the Ely vicinity. Based on the work of R. R. Wooley and others in Utah generally 400 to 600 cubic feet per second per square mile can be expected in small basins at about the same latitude as Ely, although even this can be exceeded by severe events. (41)

Suspended sediment included in the flood flows increased the total peak of the flood flow by one percent and the total volume by .6 percent. (26) This tends to indicate that sediment will not be significant in increasing peaks.

These observations in Walnut Gulch, coupled with observations recorded by Trimmer of the Bureau of Land Management in the Duckwater area of Nevada in 1965 and on the scene observations in Murry Canyon in 1968 by Ranger Albrechtsen, serve as the basis for the assumptions used in evaluating the potential floods and treatment effectiveness.

Even though these evaluations represent a string of speculations which may strain the available facts, it was felt that they provided a valid approximation of the hydrologic function of the watershed under the stress of high intensity storms.

FLOOD DAMAGE AND POLLUTION REDUCTION THROUGH MANAGEMENT

The foregoing sections have described the general physical makeup and function of the area, both under normal and under stress conditions. The next section is in four parts. The first presents a flood chronology and flood frequency information. The second discusses problems with culinary water pollution and control possibilities; the third discusses related floods in excess of storm drain capacity and possible treatment possibilities; and the fourth deals with some economic criteria.

Chronology of Recorded Floods From Murry Canyon. (More detailed information appears in Appendix).

August 23, 1901	Cloudburst flood
August 9, 1904	Cloudburst flood
August 20-21, 1906	Cloudburst flood
August 26, 1913	Cloudburst flood
August 2, 1922	Cloudburst flood
March 13-15, 1935	Concurrent flooding with Gleason Creek
August 10, 1936	Cloudburst flood
March 11-12-13, 1945	Concurrent flooding with Gleason Creek
March 20-21, 1956	Concurrent flooding with Gleason Creek
July 22, 1968	Cloudburst flood

Other Important Events

1901	Ice plant constructed in Ice Plant Canyon.
Spring 1906	Ely Daily Times warns of dangerous water pollution.
Summer 1906	Construction of ditch from Murry Creek around to point above courthouse.
Sept. 1918	Typhoid epidemic in Ely.
1956	Construction of Murry Canyon storm drain.
1962	Reconstruction of Federal Highway up Murry Canyon.

On the average storm events contaminate the water supply about once every three years. It is important to note that the only lives lost, as a result of floods, are related to flooding from Murry Canyon.

If a damaging summer storm occurs there is a 60 percent chance that it will occur between July 22 and August 31. During this period the odds are in favor of the event occurring the last 10 days in July or the second week in August.

Some other factors affecting cloudburst storms are that the 8,000-foot elevation is generally the upper limit of damaging intensities. The greatest damage is from basins of 10 square miles or less. Years of greatest temperature generally produce the greatest storm activity. Rates of flow of 400 to 600 cubic feet per second per square mile can be expected. (41)

Culinary Water Pollution Control.

One of the major problems related to cloudburst activity is contamination of the city spring. This contamination can come as a result of overflow onto the spring area and then entry adjacent to vent pipes or through one of several collection-box lids.

There is also the possibility of contamination of this spring at points outside the watershed. This type of pollution will be difficult to treat without knowledge of the ground water systems and possible points of water contamination from the surface. The types of pollution have not been ascertained completely. It has been assumed that suspended sediment is the primary constituent in this contamination. The source and type of pollution should be ascertained in order to assure effective treatment.

Possibilities for onsite treatment include sealing the collection-box lids and closing any other points where surface flow can enter the system and elimination of the existing surface water collection system.

Protective dikes should be installed around the primary collection points allowing as much area as possible outside the dike for flood flows to dissipate their energy, maintaining the maximum possible area for water spreading outside this dike. The eastern section of the north protection fence should be provided with trenches which will divert surface water flow away from the spring.

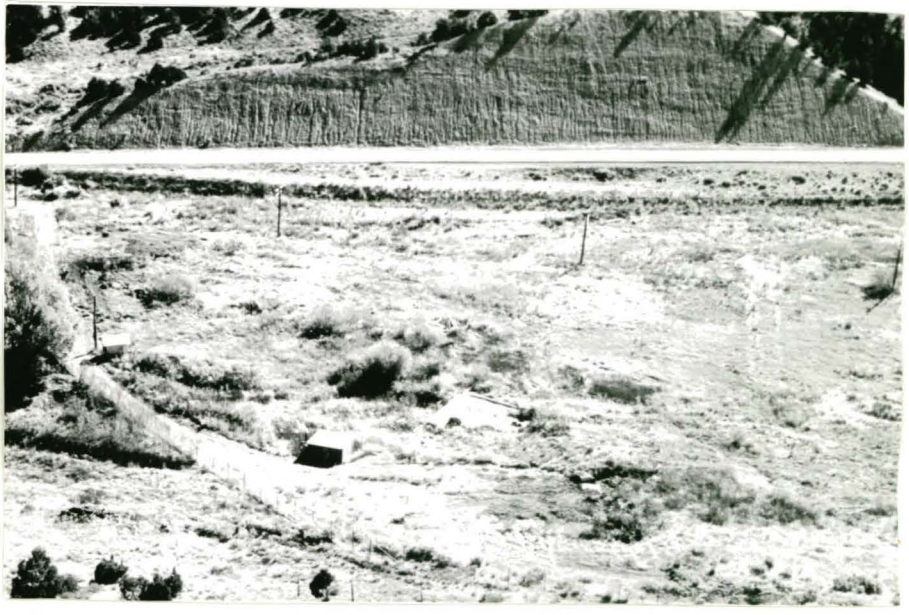

Photo No. 9 General view of spring area showing the surface-water collection basin (two o'clock position from house in the foreground) and the collection-box lid (three o'clock position from same house).

Photo No. 10 Surface water collection basin which is one of the most probable sources of pollution during summer storms. This should be eliminated from the system.

Photo No. 11 Collection-box lid positioned in a depression three feet below ground level.

The chlorination system had been destroyed by vandalism. It should be replaced, shielded against bullets, and maintained in continuous operation.

Observations above the spring area in Elderberry Canyon indicate the area has been used as a garbage dump. This practice is continuing and provides additional contaminates to the system during high flows. This practice of dumping should be stopped and measures taken to enforce a ban against it. Consideration should be given to burying existing garbage, if further studies warrant.

The spring area should remain under close scrutiny to determine if pollution is consistently linked to storm activity in Murry Canyon or if in some cases there is pollution with no associated storm. If the latter case exists, studies should be requested from the U. S. Geological Survey or the University of Nevada to determine the character and location of the ground water flow and possible points of contamination.

Additional valves controlling spring collection lines would be valuable in being able to select lines with less contamination during these events.

Some protection from larger events will be provided by measures to reduce cloudburst flood peaks. These measures probably will not be very effective unless combined with the recommended work on the spring area.

Summer Storm Related Floods in Excess of Storm Drain Capacity.
Flood flows generally concentrate in the main channel of Murry Canyon. In some cases, this main drainage has been realigned and straightened to provide confined passage for water by the highway, resulting in an increased gradient. These flows then pass down the canyon to an alluvial plain above Murry Spring where they spread out reducing the impact of the water.

Summer storms which result in floods can cause damage if they exceed a flow of 35 cubic feet per second at the intake point for the city storm drainage system. This small capacity in the storm drain is one of the critical factors in flooding. (15)

All watershed improvement work will have to be directed toward reducing the flow at this point to 35 cfs through increasing channel storage, flow regulation structures and onsite detention treatments. In evaluating possible treatments in the critical area it was found that all feasible treatments could not reduce peak flows below the 35 cubic foot per second level during periods when wet soil condition preceded the storm.

Photo No. 12 Storm drain intake point showing relatively small capacity. This capacity is estimated at 35 cfs.

Estimates based on triangular hydrographs of runoff developed from storm magnitudes and frequencies taken from Weather Bureau TP-40, indicate that the capacity of the storm drain might be exceeded by a one-hour storm on the average of once every five years with a wet antecedent moisture condition and once in 100 years under average conditions. These estimates are based on rough data, but they serve to indicate the difficulty in attempting to provide protection through land treatments or energy dissipation and flow regulation dams.

Apparent potential onsite land treatments over much of the watershed, such as trenching and pinyon-juniper conversion, are limited by several factors. The low rainfall, less than 10 inches annually, high evaporation rates and short growing season characterized by a three-month frost-free period, make vegetative recovery a highly uncertain prospect.

The other major problems are related to the generally shallow soil depth to rock-parent material and steep topography. In addition, the rates of soil movement downslope due to solifluction could present trench maintenance problems at elevations below 7,800 feet, particularly on south aspect slopes with shallow soils.

The steep gradient and the generally narrow widths do not allow for adequate reservoir storage capacities, under normal design practice for small dams, to properly regulate flood flows. Considering a structure 10 feet high; most would provide only one to three acre feet of storage. Storage of 10 acre feet or greater would be fairly effective at redistributing and regulating the flow from each of the drainages. Evaluations of treatments were made on the basis of a one-hour storm which would occur once in one hundred years with a wet antecedent moisture condition.

Photo No. 13 Road cut showing the relatively shallow depth to bedrock over much of the area. This factor severely limits onsite treatment possibilities.

Channel storage improvement could be beneficially provided in several areas, particularly in the alluvial flats above and below Murry Spring and in Elderberry Canyon. These basins adjacent to the stream could be constructed mechanically or possibly in some cases by the use of explosives. (6)

In all cases it will be necessary to determine the effect of storage of water on the flows of Murry Spring, especially with respect to water quality.

Economic Evaluation.

The Corps of Engineers estimated a cost of $25,000 per cloudburst flood for damage and cleanup in Ely, Nevada, (1958 prices). Based on seven known damaging cloudburst events, since 1900, the approximate annual cost is $2,500 in 1958 dollars. In terms of current January 1970 dollars this is approximately $3,300. Additional damages due to winter events from Murry Creek amount to approximately $400 annually, (1958 prices), prorated on the basis of proportional area and number of occurrences. This results in approximately $4,000 of annual damage attributable to Murry Canyon.

The present worth of $4,000 annually for 50 years at a rate of 4.5 percent is approximately $79,000. For 100 years at the same interest rate it is approximately $88,000. These are values for offsite damages only and include no resource damage considerations or costs as a result of culinary water contamination.

The figure of $88,000 for 16 square miles allows approximately $5,500 per square mile or $8.60 per acre in treatment expenditures. This is to the break-even point, where cost minus benefit equals zero. As noted earlier, death has resulted from Murry Canyon flooding; this factor is not considered in the economic evaluation.

TREATMENT EVALUATIONS

General Considerations.
The climatic environment of Murry Canyon is highly varied with elevation. Total rainfall appears to equal total evaporation at somewhere between 7,400 to 7,800 feet depending on exposure. Precipitation varies from nine to 30 inches annually, depending on elevation. It is fairly uniformly distributed throughout the year with most of the damaging storm events occurring in late July and August. The average growing season is approximately 100 days in length. These factors indicate the difficulty in establishing successful revegetation in treatments. The city has terraced a north aspect slope behind the Court House at an elevation of 6,500 feet. The crested wheat-grass stand is very successful indicating that lower elevations can be successfully treated, if the local climate is favorable.

Because rainfall is uncertain in amount and distribution and because of the consequences of failure of treatments, consideration should definitely be given to a treatment plan varying over a period from five to 10 years so that no large portion of the watershed is in a disturbed condition at any time. This approach should be useful in preventing severe damage as a result of cloudburst activity. All treatments are subject to Multiple Use considerations.

Previous Treatments
The treatments in Ice Plant Canyon should provide valuable "hindsight" information for further treatment measures in addition to the flood protection they now afford.

The treatments, consisting of trenching and seeding, brush dams, and a flood retarding dam, do not appear to have been subjected to a storm of the magnitude of the flood-producing storm of August 2, 1922, which originated in Ice Plant Canyon.

The treatment performance under this type of storm is, therefore, not known with any certainty at this time.

Surface Depressions-Cratering.
Large pits or craters should be constructed in several drainages to create detention storage and to improve ground water recharge. These should be particularly useful in the broad alluvial bottoms of Elderberry, Powderhouse, and main Murry Canyons.

These basins, having approximately one to three acre foot of capacity, would be relatively fail safe, in that they would be below the surface of the ground and typical short-duration flow, in excess of their capacity, would pass over them.

These craters could be formed using explosives, however, there may be damage to the spring and there would be other coordination problems.

Larger explosive craters have been used by the Corps of Engineers to construct small harbors. They used aluminized ammonium nitrate as the explosive because it detonates cleanly, it produces no noxious fumes, and thus, it does not contaminate water.

These pits would require a drop structure at the mouth and one immediately below to prevent headcutting and possible formation of continuous gullies.

Contour Trenching and Furrowing.
This treatment should be effective in those areas where annual precipitation is in excess of 14 inches and soil depths exceed four feet to solid bedrock. These trenches should be designed to handle a minimum of approximately seven cubic feet per lineal foot on about a 60-foot spacing based on one and one-fourth inches of runoff. This requirement is implied by the high magnitudes of point rainfall which might cause trench failure and flooding.

The surface-soil movement factor is also a consideration which will affect the need for maintenance if satisfactory vegetative cover is not achieved in, and adjacent to the trenches or furrows.

Pinyon and Juniper Removal.
In general, this treatment should have beneficial effects on areas with adequate precipitation and soil depth for establishment of grasses. Removal of the pinyon and juniper should result in delayed snowmelt and some reduction in frost heaving and related solifluction.

This treatment should definitely be considered in conjunction with contour trenching where esthetic considerations allow. Soil stabilization will be the primary benefit. Runoff from high intensity storms will be reduced only slightly, unless a dense grass community is established.

Ripping.
The upper basin near Murry Summit has a restricting hardpan at a shallow depth, (approximately one foot). Percolation, water retaining characteristics, and vegetative production should be improved by ripping. This ripping should be intermittent to prevent soil piping and gully formation. This treatment will have a lower priority because of the location of this area, with respect to Ely. The longer length of channel, coupled with channel treatment on the main canyon, should reduce flows from this area significantly. This treatment may also conflict with recreation planning in the upper basin.

Detention and Regulation Dams.
These structures could be effective where they can be designed to store 10 acre feet of water or more. Problems of narrow channels and steep gradient in tributary channels will make achieving this storage difficult without excessively high structures.

These dams would need to be failure-proof because of the consequences to the city of Ely, in the event of failure. This implies that spillways must be designed to pass the maximum probable flood without causing failure of the structures. In general, this type of structure is considered infeasible.

Diversion.

Possibilities for diverting flood waters adjacent to a proposed Highway Six bypass through Murry Canyon, as recommended by the Soil Conservation Service, have been considered. All other treatments, apparently, will not guarantee a flow of 35 cubic feet per second or less at the storm drain intake.

A review of the proposed alignment indicates that it will not provide diversion in its present location. Rough approximations from a contour map based on a grade sufficient to carry the water past Ice Plant Canyon indicate that a fill of approximately 60 feet would be required in Elderberry Canyon and a fill of 120 feet, in addition to an alignment change, would be required in Ice Plant Canyon to achieve water grade.

Discussions with the local state highway engineer indicate this route change is a four-plus years away and incorporation of flood control works in the road alignment or adjustments in the alignment do not appear feasible.

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APPENDIX

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Appendix B — July 1968 Storm and Flood Analysis

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MURRY CANYON CHANNEL TREATMENTS

CAPACITY		CUBIC YARD EXCAVATION			
ACRE FT.	CU. YDS.	CITY	FS	BLM	TOTAL
.3	500	0	0	500	500
.6	1,000	0	2,000	8,000	10,000
.9	1,500	0	1,500	0	1,500
1.2	2,000	0	2,000	4,000	6,000
1.5	2,500	0	10,000	0	10,000
2.5	4,000	4,000	8,000	8,000	20,000
3.1	5,000	5,000	10,000	5,000	20,000
TOTALS		9,000	33,500	25,500	68,000
COST @ $.70/YD^3		$6,300	$23,450	$17,850	$47,600

BASIN SPILLWAY AND CHANNEL CONTROL

SPILLWAYS	2	12	14	28
CHANNEL CONTROLS	2	12	14	28
	4	24	28	56
COST @ $500 EACH	$2,000	$12,000	$14,000	$28,000
TOTAL COST	$8,300	$35,450	$31,850	$75,600

ONSITE TREATMENTS

ITEM DESCRIPTION	CITY	FS	BLM	TOTAL
Drop Structures Cost @ $250	1 $250	9 $ 2,250	23 $ 5,750	33 $ 8,250
Road Erosion Contr. (Miles) Cost @ $100/mile	1 $100	10 $ 1,000	10 $ 1,000	21 $ 2,100
Contour Trenching (Acres) Cost @ $80/acre	0 $ 0	1150 $112,000	100 $ 8,000	1250 $120,000
Contour Furrowing (Acres) Cost @ $15/acre	0 $ 0	0 $ 0	350 $ 5,250	350 $ 5,250
Rip-Furrow-Seed (Acres) Cost @ $21/acre	0 $ 0	200 $ 4,200	300 $ 6,300	500 $ 10,500
Selective P-J Removal (Acres) Cost @ $10/acre	0 $ 0	1000 $ 10,000	750 $ 7,500	1750 $ 17,500
ONSITE TREATMENT COST TOTALS	$350	$129,450	$33,800	$163,600

MURRY CANYON PROJECT TOTAL COST

	CITY	FS	BLM	TOTAL
CHANNEL TREATMENTS	$ 8,300	$ 35,450	$31,850	$ 75,600
ONSITE TREATMENTS	350	129,450	33,800	163,600
SUB-TOTAL	$ 8,650	$164,900	$65,650	$239,200
ADMINISTRATIVE +30%	2,595	49,470	19,695	71,760
GRAND TOTAL	$11,245	$214,370	$85,345	$310,960

EVALUATION OF FACTORS RELATED TO JULY 22, 1968 FLOOD

BY

LARRY SCHMIDT

This evaluation is being made in order to better understand the type of storm which could create a flood of 400 cfs, as observed in 1968.

Data:

All the data for this evaluation comes from Flood Damage Report in Murry Canyon Watershed, White Pine Ranger District, Humboldt National Forest, 1968, by Benny Albrechtsen, DFR, Ely, Nevada.

The following factors were well defined:

1. Storm duration - $\cong$ 1 hour
2. Peak volume - $\cong$ 400 CFS
3. Time of peak - $\cong$ 4:20 p.m. PDT
4. Recession characteristics - $\cong$ 100 cfs approximately in 10 minutes, continued for 40 minutes
5. Approximate storm area - $\cong$ two square miles

Using the above information storm magnitudes were varied on a computer and triangular design hydrographs created to find out what magnitude could create the observed peak.

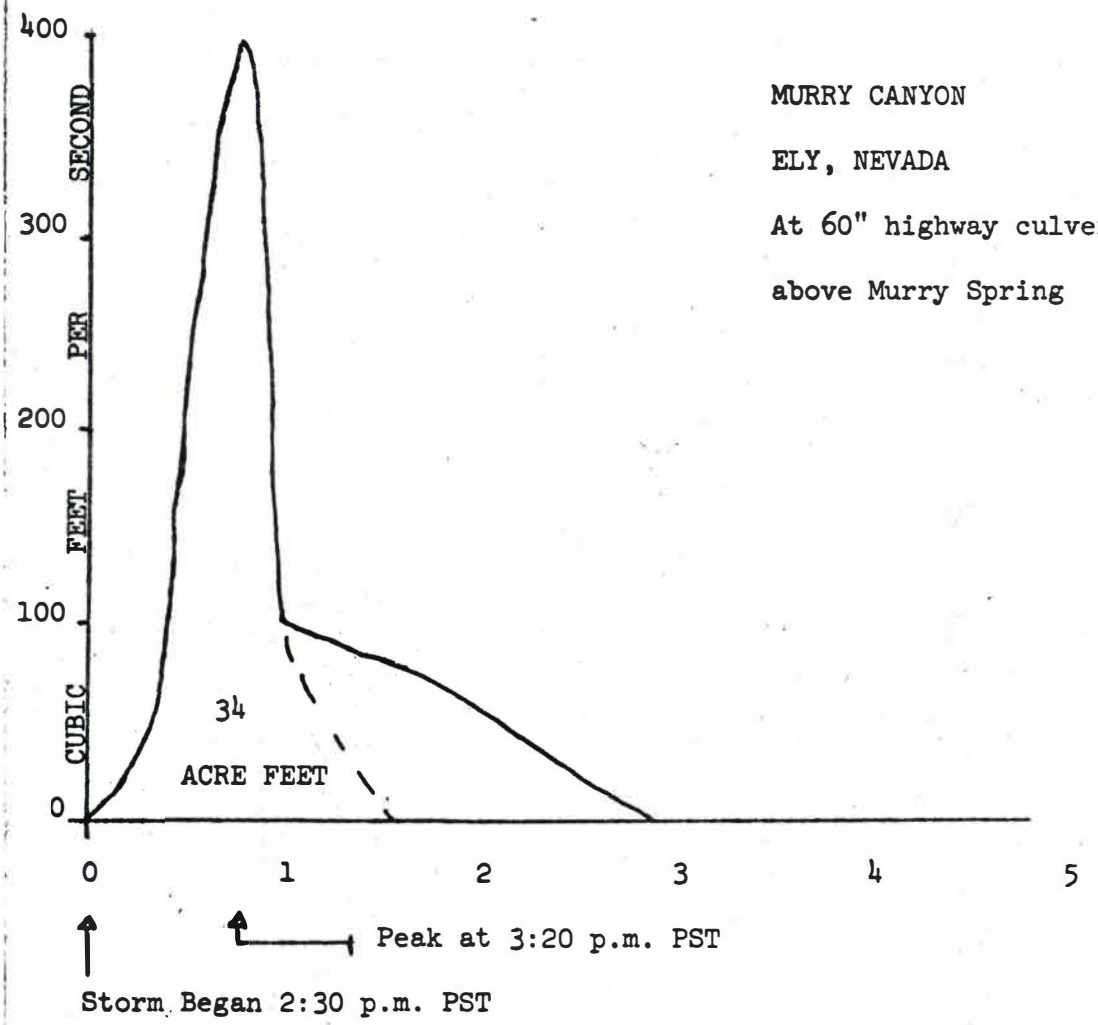
Results:

Under average soil moisture conditions it is estimated that a storm of two inches, lasting one hour, and having a duration of surface runoff of one hour could have caused the 400 cfs peak. The associated volume would be approximately 35 acre feet.

Under wet soil conditions it is estimated that a storm of one inch, lasting one hour, and having a duration of surface runoff of one hour, could have caused the 400 cfs peak. The associated volume of water would be approximately 35 acre feet. A one-inch-in-one-hour rate has a recurrence interval of once in 50 years, according to Weather Bureau TP-40 data.

ESTIMATED FLOOD HYDROGRAPH

FOR JULY 22, 1968 STORM



MURRY CANYON

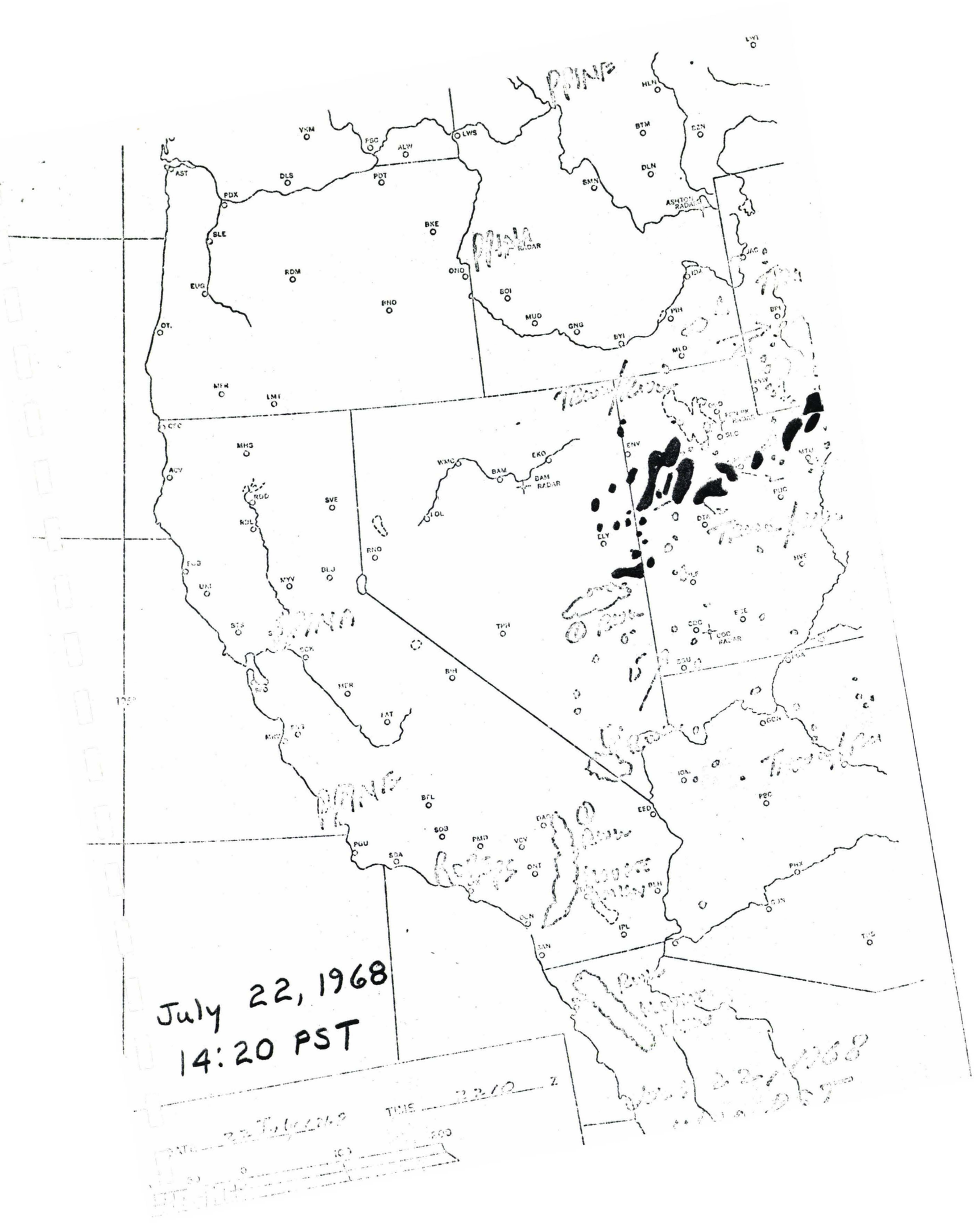
ELY, NEVADA

At 60" highway culvert

above Murry Spring

FS

TIME IN HOURS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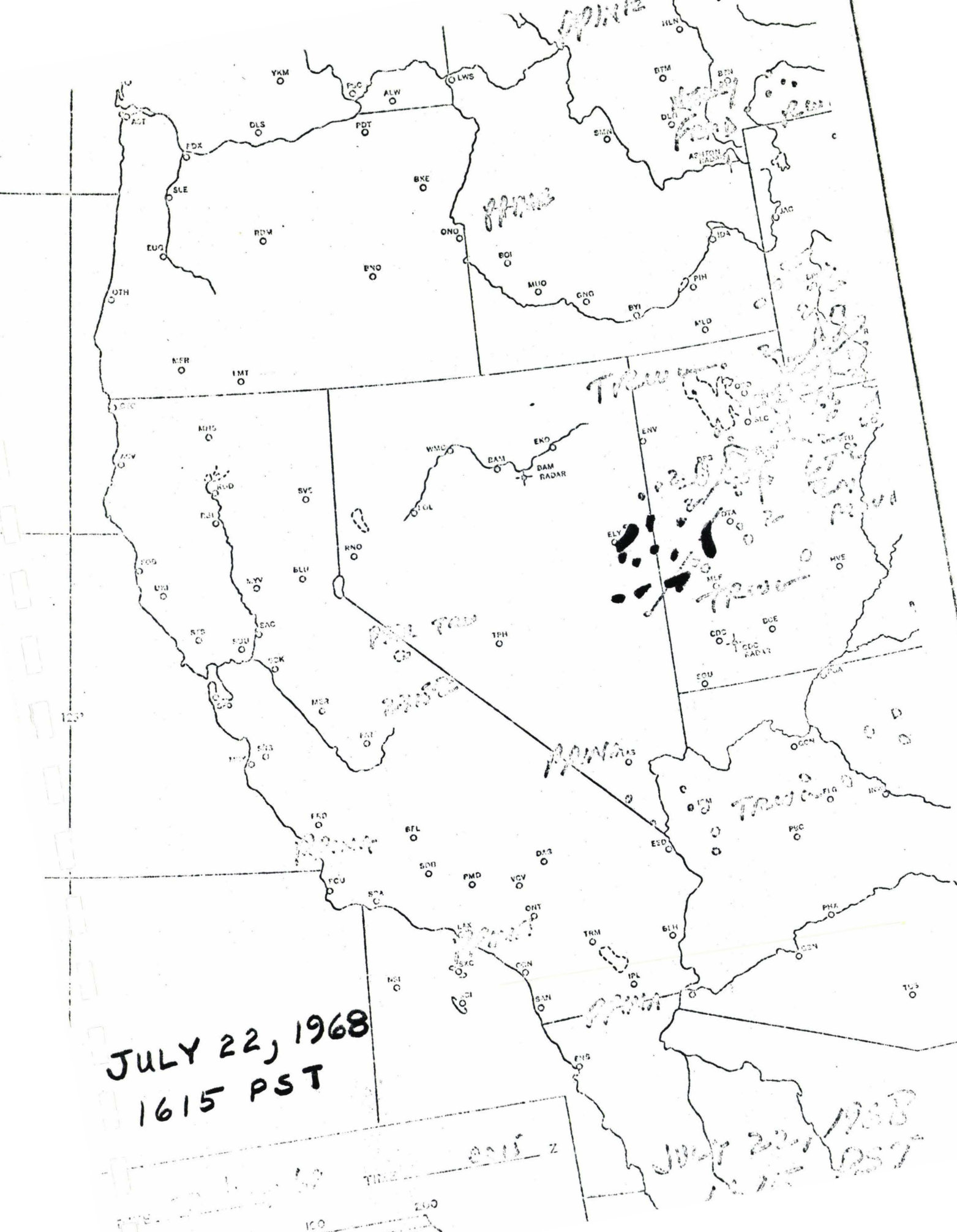
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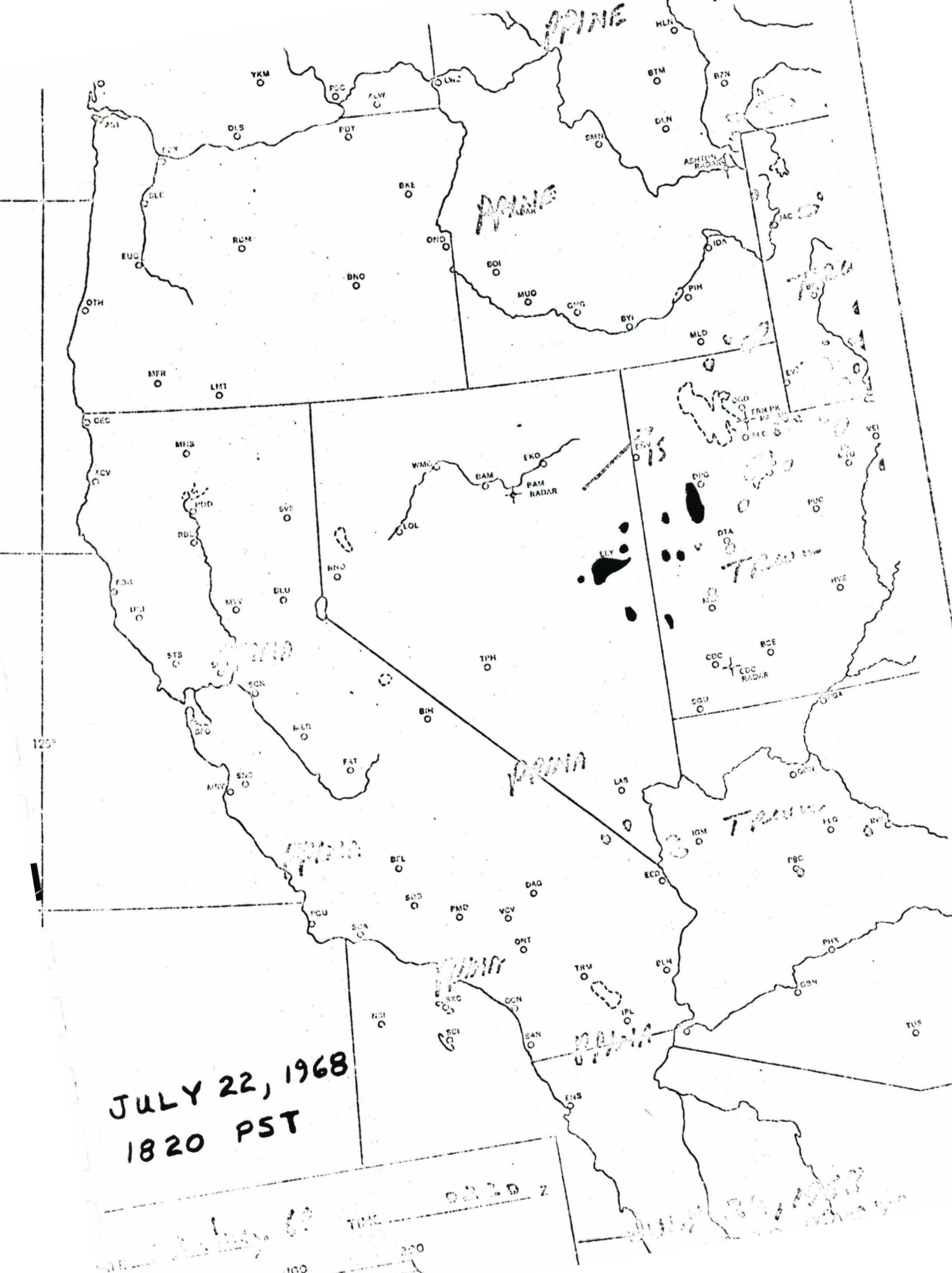
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ARCO
TWIN FALLS
BURLEY
POCATELLO
IDAHO FALLS
PROVO
SALT LAKE CITY
GRAND JUNCTION
GRAND JUNCTION RADAR
MONTROSE
DURANGO
FARMINGTON
ALBUQUERQUE
GALLUP
WINSLOW
FLAGSTAFF
PRESCOTT
KINGMAN
LAS VEGAS
ELY
RENO
BISHOP
MERCED
FRESNO
SAN LUIS OBISPO
SANTA MARIA
LOS ANGELES
SAN DIEGO
EL PASO
ALBUQUERQUE
SANTA FE
TUCSON
PHOENIX
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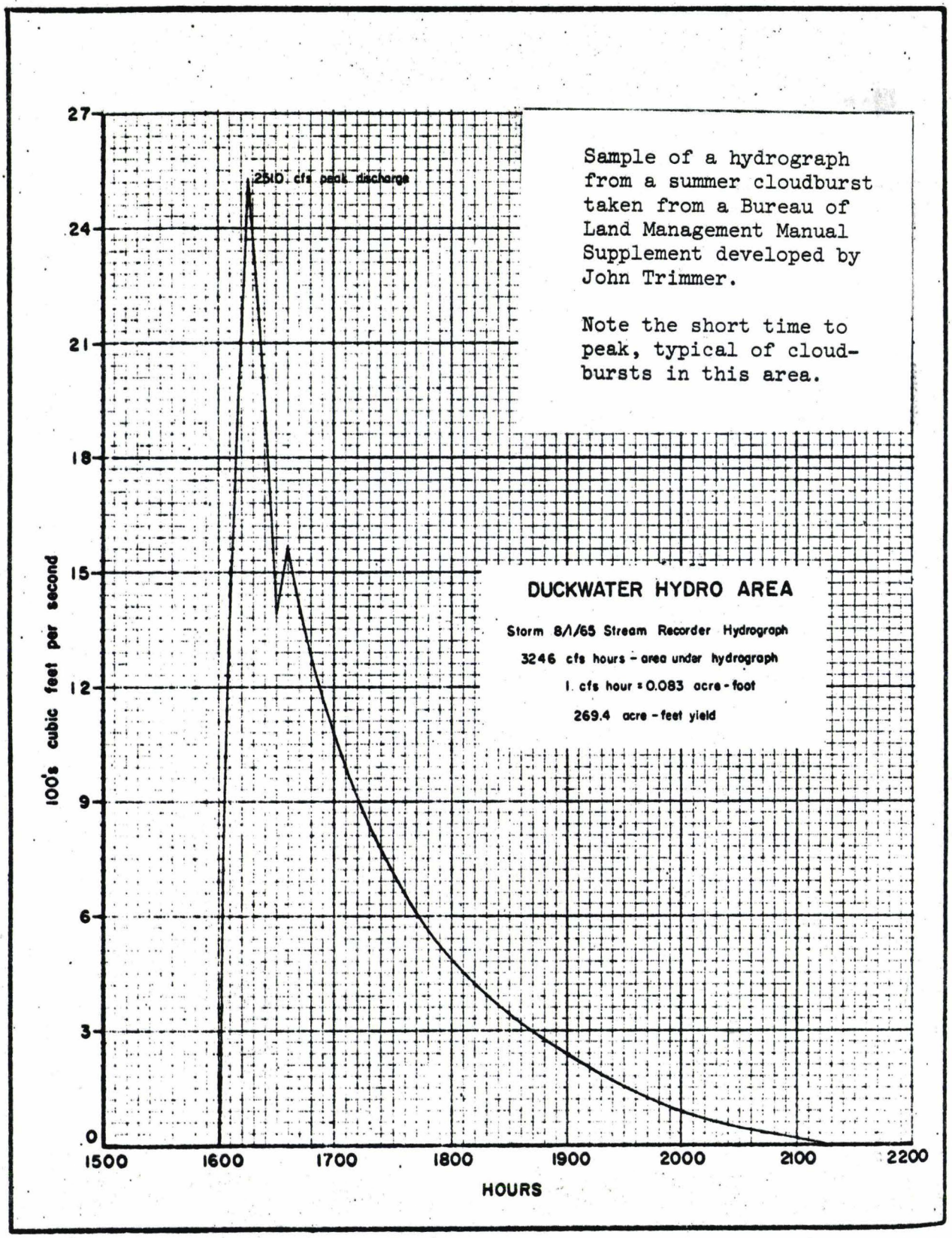
APPENDIX C

9173 - STUDIES AND HYDROLOGY

DUCKWATER STREAM HYDROGRAPH



APPENDIX D

STORM FREQUENCYS AND MAGNITUDES

PROBABLE MAXIMUM PRECIPITATION 1/

Duration in Hours	Inches of Precipitation
0.5	2.55
1.0	2.78
3.0	6.05
6.0	6.70

ONE HOUR PRECIPITATION FREQUENCYS AND MAGNITUDES 2/

Frequency	Magnitude
5 Year	.60
10 Year	.70
25 Year	.80
50 Year	1.00
100 Year	1.30

1/ Corps of Engineers, Gleason Creek Report

2/ Weather Bureau TP-40

APPENDIX E

Lower Drainage Slopes 001

001A Consists primarily of pinon-juniper slopes of 40 to 60 percent slope. Ground cover ranges from 30 to 40 percent on the gravelly clay limestone soil. Bare ground amounts to approximately 15 percent of the area with an additional 25 percent covered by rock. High flash-off water delivery can be expected from high intensity summer storms.

001B Pinon-juniper slopes of 30 to 50 percent. Ground cover on the shallow silty clay loam soil amounts to 25 to 35 percent with 40 percent exposed rock and 20 percent bare ground. High runoff may be expected to accrue from the limestone slopes.

Deep Alluvial Bottoms 002

002A Pinon-juniper canyon side slopes with slope of 15 to 35 percent surround the sage-grass bottom. The ground cover (40 to 50 percent) accounts for most of the surface area. The loamy alluvial limestone soils can be expected to handle all but the high intensity summer storms.

002B Pinon-juniper slopes of 40 to 70 percent. The loamy silt is covered 65 percent by rock with 20 to 25 percent being bare ground. Ground cover on the alluvial sandstone amounts to only 10 to 15 percent. Heavy runoff may be expected from all types of rainstorms accompanied by sheet erosion.

002C Sage-grass alluvial bottom sloping 0 to 10 percent. Loamy clay soil supports fair ground cover (45 to 60 percent) with most of the remaining area bare ground and rock. Due to lack of slope, soil type, ground cover excessive runoff from this area is unlikely. Precipitation is greater and ground cover should be dense. A hardpan restricts infiltration and percolation of water.

Gentle Basin Slopes 003

003A Sage-grass basin with slopes of 35 to 45 percent. The shallow sandy clay loam soil supports ground cover of 35 to 45 percent. Limestone bedrock exposures are prevalent. Moderate runoff may be expected with flash-off delivery from high intensity summer storms.

003B Pinon-juniper slopes of 20 to 45 percent. Shallow silty clay soils of limestone derivation support ground cover of 35 to 55 percent. Bare ground accounts for 10 to 25 percent of the area. Excessive runoff from high intensity summer storms is probable.

003C Pinon-juniper slopes of 20 to 60 percent. Total ground cover on the shallow sandy loam soil is 40 to 45 percent. Twenty to 25 percent of the area is bare ground. Excess runoff from the area will probably be handled successfully by the basin into which it drains.

1/ Taken from Hydrologic Transects on file in R-4 Division of Soil and Water Management.

Steep Main Canyon Slopes 004

004A Pinon and mountain mahogany cover slopes of 45 to 55 percent. Ground cover of 60 to 70 percent exists on the shallow silty loam soil. Twenty percent of the limestone soil is bare. Heavy runoff may be expected. Bedrock exposures common.

004B Pinon-juniper canyon wall sloping 30 to 60 percent. Shallow silty loam soils support little ground cover (20 to 25 percent). Exposed limestone outcrops are prevalent. Excessive runoff may be expected.

004C Pinon-juniper slopes of 30 to 60 percent. Ground cover of 10 to 20 percent exists on these shallow loamy silt soils. Exposed rock is prevalent (50 to 65 percent). The sandstone slopes may be expected to deliver heavy runoff from all types of rainstorms accompanied by erosional debris.

Gentle Upper Basin Slopes 005

005A Pinon-juniper-sage basin slopes of 10 to 30 percent. Shallow silty loam soils of sandstone derivation support ground cover of 75 to 80 percent. Excessive runoff is unlikely.

005B Pinon-juniper slopes of 5 to 25 percent. The clay loam soil is derived from limestones. Existing ground cover amounts to 50 to 60 percent with 25 to 30 percent rock and 15 to 20 percent bare ground. Runoff is likely to occur by concentration and delivery in excessive quantities is unlikely.

Highly Dissected Steep Slopes 006

006A Pinon-juniper slopes of 25 to 40 percent. Soils tend to be shallow and loamy supporting ground cover of 25 to 40 percent. Bare ground on these limestone soils ranges from 15 to 30 percent with rock accounting for another 35 to 50 percent. Flash-off may be expected from high intensity summer storms.

006B Pinon-juniper slopes of 35 to 45 percent. Fifty to 55 percent ground cover exists on the shallow loam soils. Bare ground accounts for approximately 20 percent of the area with an additional 25 to 30 percent attributable to exposed rock. The limestone slopes may be expected to produce high runoff yields from high intensity summer storms. Probably represent optimum condition.

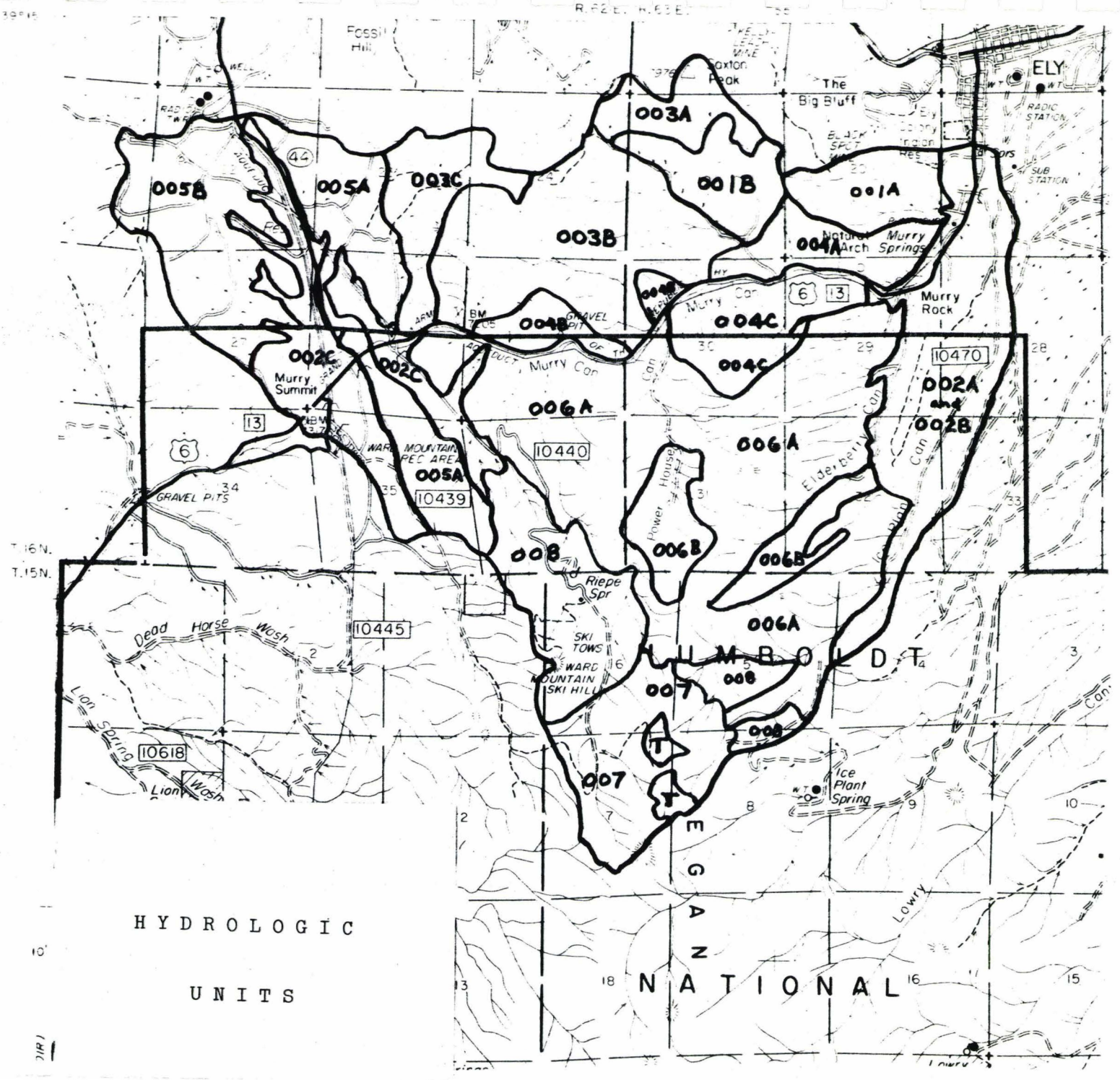
High Altitude Steep Smooth Slopes 007

007 Sage-grass slopes of 15 to 40 percent. Good ground cover exists on the moderately deep loams. These limestone soils can be expected to handle all storms with relatively little damage.

007T Upper watershed slopes which have been treated in the past.

High Altitude Irregular Slopes 008

008 Mountain brush with slopes of 15 to 55 percent. Shallow loamy soils of limestone derivation are covered by 25 to 30 percent rock and 50 to 60 percent ground cover. The soil type and fair ground cover cause this area to be reasonably efficient in handling precipitation. Excessive runoff is unlikely. Performs somewhat similarly to 007.


HYDROLOGIC
UNITS
ELY
The Big Bluff
Fossil Hill
Boxton Peak
Murry Summit
Murry Rock
Murry Springs
Natural Arch
Murry Can
Elderberry Can
Power House
GRAVEL PITS
WARD MOUNTAIN REC AREA
WARD MOUNTAIN SKI HILL
SKI TOWS
Riepe Spr
Dead Horse Wash
Lion Spring
Ice Plant Spring
Lowry
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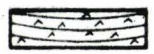
HUMBOLDT
NATIONAL

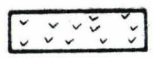
STANDARD SYMBOLS FOR WATERSHED REHABILITATION WORK

Contour Trench

Contour Furrow (Large Holt)

Contour Furrow (Small Holt)


Plow and Seed


Seeding

Gully Plugs (Rock, Brush, Log, Metal, Other)

Headcut Structures

Sloping Gully Sides

Grass Waterway

Debris Basin

Trail Erosion Control

Road Erosion Control

Road Obliteration

Drop Structures

Vegetation Planting for Channel Stabilization

Structural Streambank Stabilization

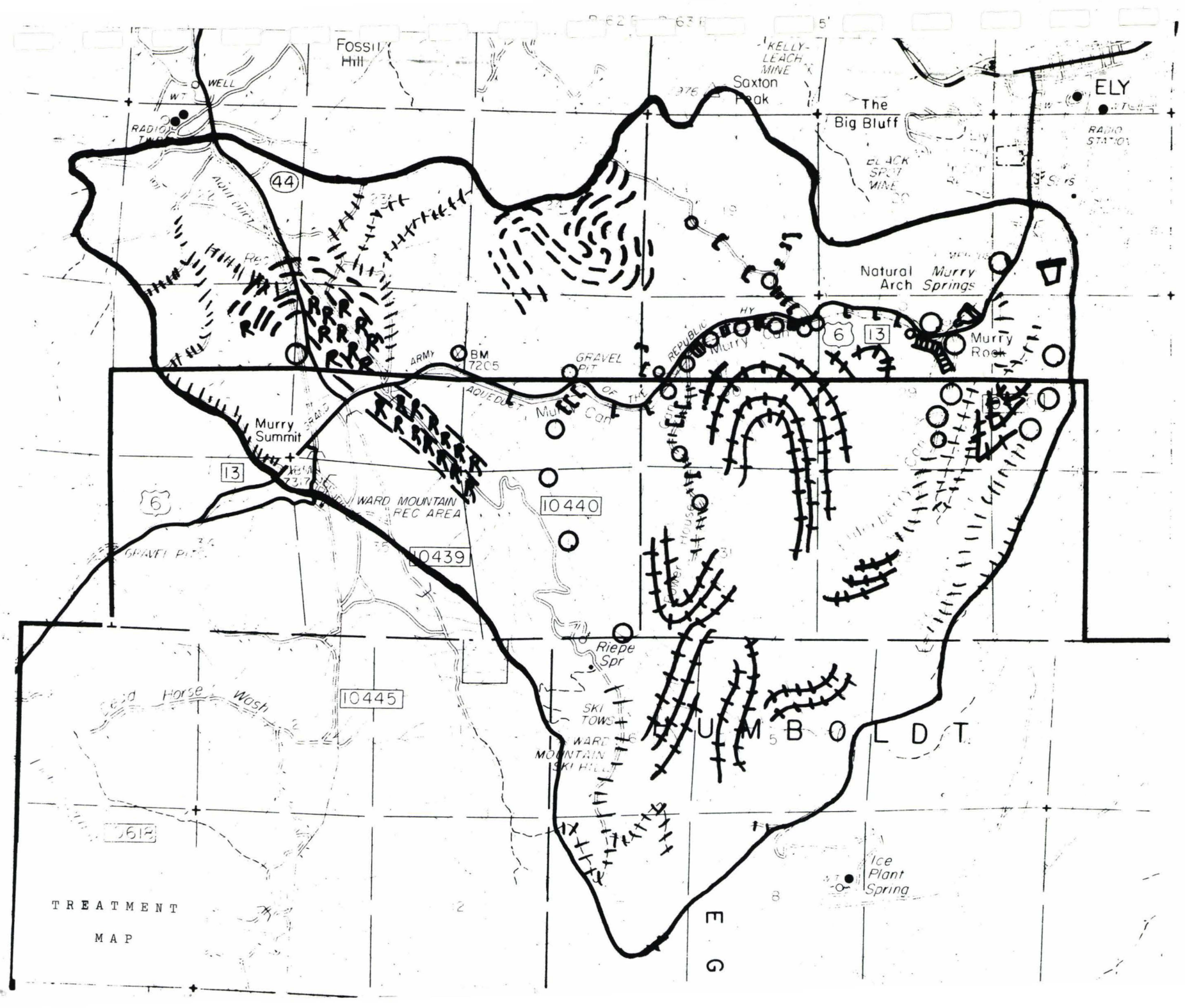
Fence Existing

Fence Proposed

R R R R R
R R R R Rip and Seed (Contour)

+ + + + + Chain

Basins

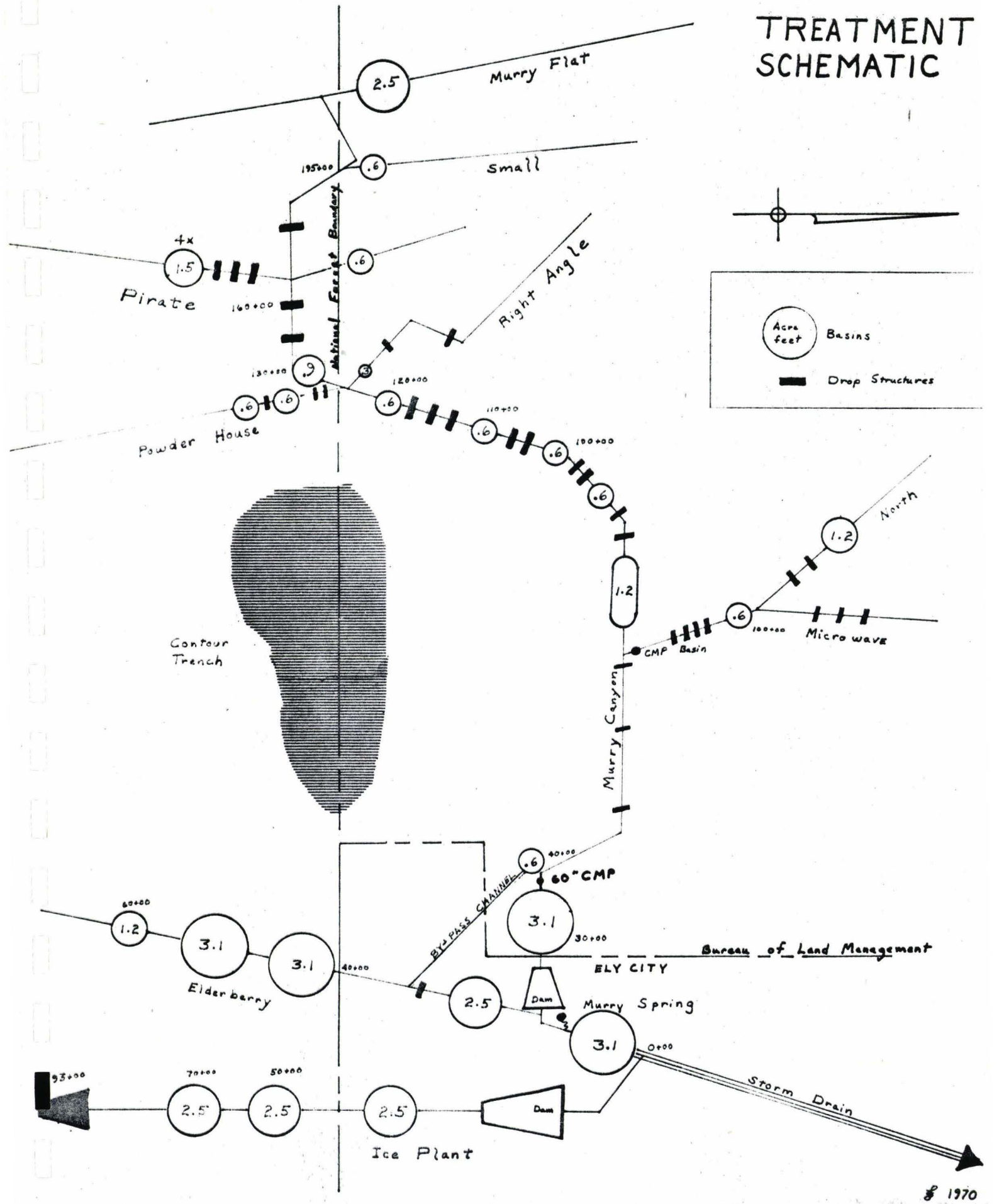

Fossil Hill
WELL
WT
RADIO TWR
44
KELLY-LEACH MINE
Saxton Peak
The Big Bluff
ELY
RADIO STATION
BLACK SPOT MINE
Natural Arch
Murry Springs
Murry Road
6
13
BM 7205
GRAVEL PIT
ARMY
AQUEDUCT
Murry Summit
WARD MOUNTAIN REC AREA
10440
10439
10445
Riepe Spr
SKI TOWS
WARD MOUNTAIN SKI HILL
Horse Wash
HUMBOLDT
Ice Plant Spring
TREATMENT
MAP

T R E A T M E N T D I S T R I B U T I O N

SUB-DRAINAGE SUB-DRAINAGE	CONTOUR FURROW (ACRES)	CONTOUR TRENCH (ACRES)	CONTOUR RIP AND FURROW (ACRES)	BASINS (EACH) 0.6 AC/FT	0.9 AC/FT	1.2 AC/FT	1.5 AC/FT	2.5 AC/FT	3.1 AC/FT	DROPS DROPS
MAIN MURRY		300		5	1	1			2	15 (18)*
PIRATE		200					4			3 (8) *
MURRY FLAT	130		260					1		(2) *
UPPER ICE PLANT		80 compltd +300								
ELDERBERRY		200				1		1	2	1 (8) *
POWDER HOUSE		250		2						3 (4) *
NORTH	120			1		1				6 (4) *
LOWER ICE PLANT								3		(6) *
RIGHT ANGLE	100			1						2 (2) *
MICROWAVE										3
SMALL				1						(2) *
TOTALS	350	1250	260	10	1	3	4	5	4	33 (54)

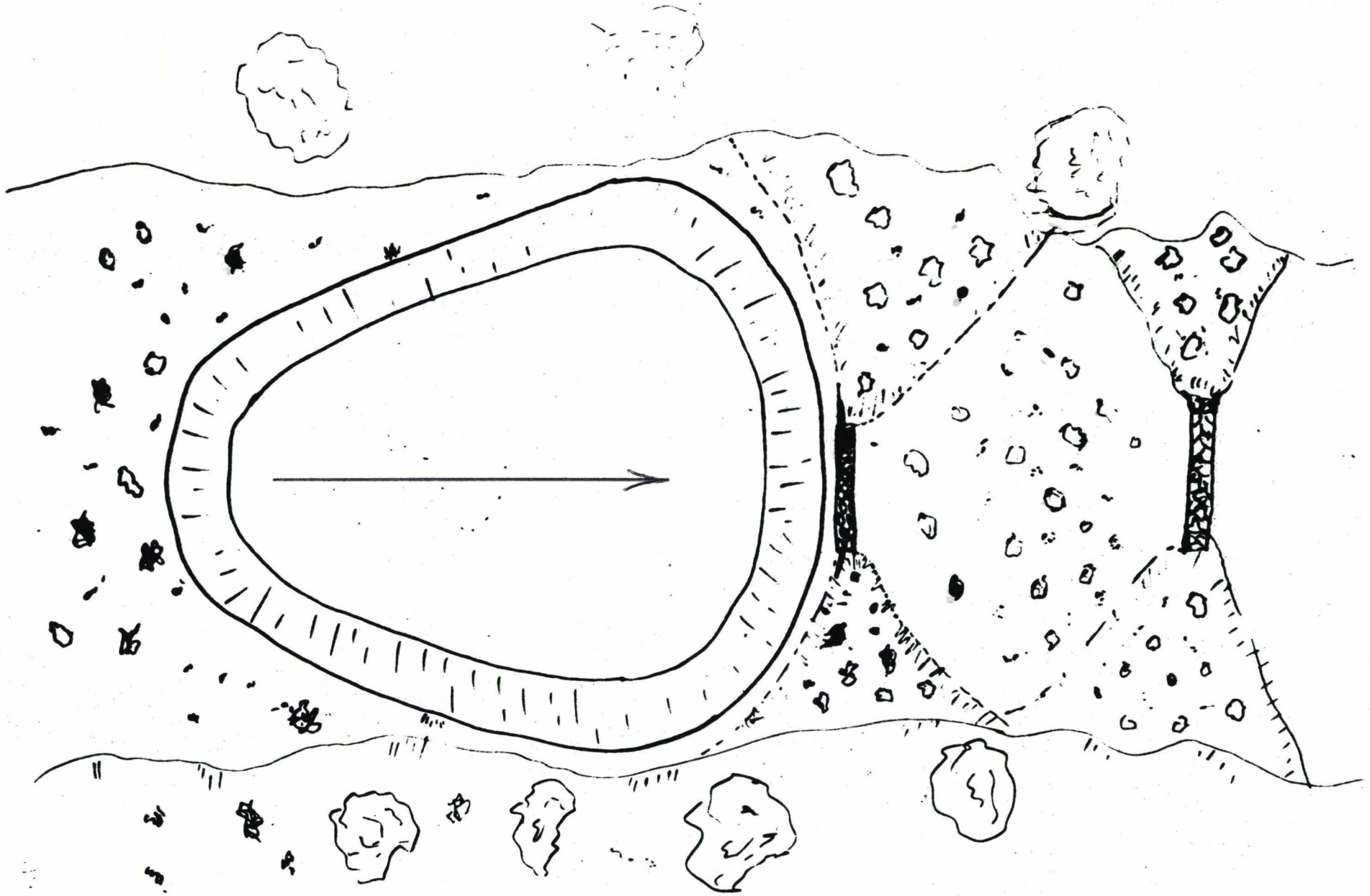
* Numbers in parenthesis represent spillway and channel controls associated with basins.

TREATMENT SCHEMATIC



© 1970

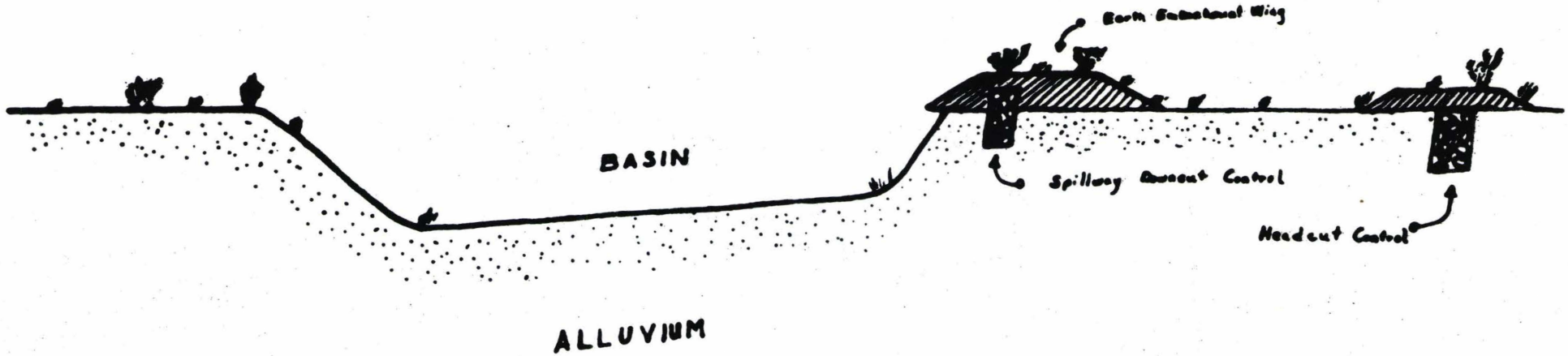
CHANNEL DELAY BASIN



TOP VIEW

1970

CHANNEL DELHI
BASINS



10 feet

PROFILE VIEW

E 1970

APPENDIX G

EVALUATION OF PRESCRIBED TREATMENT MEASURES ON FLOWS

In order to more fully understand the benefits and limitations of proposed treatments in Murry Canyon a characteristic one-hour 100-year storm was placed over each of 10 major sub-drainages and then routed under present conditiions and under future conditions with treatment. To perform these evaluations the modified Puls or storage indication method was used in a short-cut form. Trenching was assumed 100 percent effective and the contributing acreage eliminated by treatment was subtracted from the basin acreage before computing the triangular hydrograph of runoff.

Since observations tend to indicate that during any flood event one drainage is the prime contributor, and since the key purpose of this evaluation is to show relative changes rather than actual values of flow, this approach was used.

The one-hour 100-year storm, under wet conditions, was used as a basis for evaluation of runoff from each watershed.

It should be kept in mind that these figures assume complete channel treatments in addition to prescribed onsite contour trenching or furrowing.

Due to limited data and time these figures must be considered gross approximations. The limited existing data does not lend itself to a rigorous analysis of the effects of proposed land treatment.

The runoff reductions are significant on an individual drainage basis, however, combinations of flows from more than one drainage can create quite a different peak flow. Possible flow combinations suggest that even with treatment the proposed Murry storm drain should be capable of handling approximately 1000 cfs. This figure allows approximately a 100 percent safety factor based on three sub-drainages contributing.

PEAK FLOW REDUCTIONS WITH TREATMENT

FOR MURRY CANYON 1/

SUB DRAINAGE	APPROX. ACREAGE	RUNOFF VOLUME AC/FT	PRESENT			WITH PROPOSED TREATMENT			
			PEAK FLOW AT SUB DRAINAGE MOUTH	PEAK FLOW AT PROPOSED STORM DRAIN WRKS	% REDUCTION NATURAL	PEAK FLOW AT SUB DRAINAGE MOUTH	PEAK FLOW AT PROPOSED STORM DRAIN WRKS	% REDUCTION TREATED	NET % REDUCTION IN PEAK WITH TREATMENT
MAIN MURRY	1240	50	520	520	0	400	360	10	10
PIRATE	1200	33	375	320	15%	375 (310)	250	33	18
MURRY FLAT	1160	32	350	285	18%	350 (270)	170	50	32
ICE PLANT UPR	970	37	380	330	10%	380	330	10	0
ELDERBERRY	770	23.2	390	360	8%	390 (290)	170	56	48
POWDER HOUSE	560	11.4	215	180	16%	215 (120)	0	100	84
NORTH	400	18.4	295	265	9%	212	0	100	91
ICE PLANT LWR	360	9.9	175	175	0	0	0	100	100
RIGHT ANGLE	340	17.9	275	235	15%	195	0	90	75
MICROWAVE	200	9.0	220	165	23%	220	0	100	76
SMALL	120	5.	140	35	76%	140	0	100	24

1/ Based on one-hour 100-year storm, wet antecedent condition, using storage indication method.

APPENDIX H

EXCERPTS OF SUMMER CLOUDBURST FLOOD HISTORIES

FOR MURRY CANYON, ELY AND VICINITY

1. 1901, Thursday and Friday, August 22,23. The White Pine News

"Flood Notes. On Thursday evening a flood swept down Steptoe Valley covering the lowland to depth of a foot or more, and on Friday, a so-called cloudburst deluged the country to the west of town. The streams of water pouring down the mountain sides covered the road up the canyon with boulders and debris and the flood which swept through town was the greatest ever known here. Many citizens watched the torrent with anxious eyes, being fearful lest some of their property might be carried off, but fortunately no serious damage was done.

The deluge is said to have uncovered a copper ledge at the Robust, and Superintendent Doty will undoubtedly give the elements due credit if it develops into a rich deposit."

2. 1904, Tuesday, August 9. The White Pine News, August 11, 1904

"It Was A Corker! Tuesday evening Ely was visited by a thunder storm and a display of lightning pyrotechnics that was a corker. The thunder roared and the lightning flashed, and the water came down with a deluge's crash - the streets were running full of water, and with the electric lights shut off, each flash of lightning revealed a dismal looking burg. It was a corker while it lasted."

1904, Tuesday, August 9. The White Pine News, August 18, 1904

"During the heavy storm last week the road to White River through the canyon [Murry] south of town was washed out so badly that it is impassable for teams, the stage now going and coming via the Ruth. The commissioners are having the road repaired. Every road in the county has been more or less washed out and will require considerable repairing."

3. 1904, Friday, August 19. The White Pine News

"Not as Bad as Expected. [Gleason Creek] On Friday afternoon last word was brought to Ely that a cloudburst, forty-five feet wide and ten feet deep, was coming down past Lane City, and that the little camp above us was already covered with three feet of water. Of course the outlook was not a pleasant one for this town, as a volume of water of such magnitude could create untold damage. All the necessary precautions were taken to guard against the coming danger, and confidence was freely expressed that the ditch above town would be able to carry the water safely through town. A steady rain fell here during the night. About 3 o'clock Saturday morning the flood reached Ely. No damage was done, and a sigh of relief passed through the town."

4. 1906, Friday, August 17. The White Pine News

"A cloudburst occurred . . . Friday evening and . . . . . the downpour was phenomenal. Water was two feet deep in the street before it spent itself at the northern limits of Ely. There was no damage done to speak of."

5. 1906, Tuesday, August 21. The White Pine News

"Over two inches of rain have fallen since the present storm began. Murry creek may go out of its banks and for fear that it would D. S. Dickerson moved his family to High street."

6. 1913, Sunday, August 26. White Pine Lang Syne by Effie Read, 1965

"Threatening clouds made an appearance early on the morning of August 26, 1913. A black ominous cloud hung over 11,000-foot Ward Mountain to the south. The clouds came over with a sure promise of violence, and, at eleven o'clock that morning, thunder crashed and lightning struck. With another crash, the cloud burst open. People watched its funnel-like appearance with anxiety. Then an avalanche of water poured down on Murry Canyon and into downtown Ely, where Hotel Northern felt the bulk of its force.

H. O. "Tex" Hall, manager of the Northern Hotel, had a supply of expensive liquors and cigars stored in the basement. The storage room extended under the sidewalk. Since Hall feared his supply might be destroyed by the deluge, he sent Oscar Upwall, Eddy Hillick, and Frenchie Vautrin below to bring the cases to the upper floor.

The water was coming in fast, and they were moving the cases bucket-brigade style. Frenchie was calling, "Where are those high-priced cigars?"

"All at once, I heard a bang," said Vautrin, recalling the experience, "We were under the sidewalk, and I thought the building had collapsed."

"A heavy slab door had broken out between the boiler room and the stock room. A room full of water came at us, with more coming through the coal chute. It had such volume and force that it was a veritable whirlpool. It whirled, whipping up barrels and boxes and spinning them around. Oscar wrapped his arms around a barrel and was whirled close to the stairway to safety, but Eddy and I were caught between the casing and the stock room door which was forced shut by the on-rush of water. Water was up to our armpits and coming higher. I thought, 'We'll climb on the shelf,' which was merely a table for support of floor joists.

"'Follow and hang on tight,' I directed. We reached the space and climbed onto the ledge. I began beating with my fists on the floor, while Eddy kept saying, 'I can't breathe.'"

Above, there was a rush for axes. It seemed an eternity until they located the sound from Frenchie's already broken knuckles. It was slow work chopping through floorboards and linoleum to release him.

But where was Eddy? A floor joist separated the two men, and another hole had to be cut in the floor to release him. Minutes later a Japanese man reached under the floor, caught Eddy by the hair of the head and pulled him to safety. But it was too late. Eddy Hillick was dead. It probably was his heart. A pulmotor was hurried from the mines but it was of no avail. The flash flood of 1913 was, however, the worst tragedy associated with Tex Rickard's Ely Northern Hotel."

7. 1922, Wednesday, August 2. White Pine Lang Syne by Effie Read, 1965

"On August 2, 1922, Ely was visited by the largest and most disastrous flood since the country was settled by white men. Water came from Murry Canyon, hitting the ice plant with the bulk of its force, taking in its wake tons of coal followed by chicken houses, outside privies, and any other small buildings. As basements filled with water, many humorous incidents were created. Wilson Bates Mortuary had a number of child caskets stored in its basement, and, when the water subsided enough to permit investigation, it was found that the water had lifted them from their shelved storage, and it was quite an eerie sight to see them floating around much like boats.

Mail at the post office was placed in the highest possible place for safety, and it was reported that during the height of the flood, when the City Hall was being inundated, two squaws were confined within to sober up from a moonshine jag. City Marshall Jackson was found and he released them. It was said that they went on the water wagon for keeps.

Water interfered with the operation of the power plant, and the town was in total darkness through the night."

8. 1936, Monday, August 10. Ely Daily Times

"Ely's Daily "Cloudburst Time" Comes Today at 10. a. m., Lasts 15 Minutes. England may have its "tea time," metropolitan cities their "cocktail time" but the Ely area has the unique distinction of having a daily " cloudburst time," the only inconsistent part being that it may be in the morning, afternoon or late evening.

Today's highwater period came shortly after 10 a. m. when a heavy downpour hit the top of Murry summit, sending the flood partly thru the Mill street storm sewer and the remainder over the highway near the Ely Lumber and Coal Co.

A plug in the storm sewer at the corner of Murry and Campton sts. caused a large part of the water to overflow and run through the lower end of Murry street into Clark street. Mud and debris in huge quantities was washed over the highway near the cemetery and all WPA workmen were rushed to the scene to combat the flood. The court house lawn on the east side was covered with silt and the pond in the county park was filled to overflowing. The rain continued for approximately 15 minutes."

Drainage ditches which double for speed traps were over-flowed with coffee and cream colored water, and couldn't handle the deluge caused by the heaviest rain of the year.

Highway 50 toward Ruth was resurfaced with rocks large enough to throw wheels out of alignment, and at one time during the storm, rain was falling so hard the road seemed to disappear.

Most drivers were cautious enough to use their headlights while traveling the paved path between the two communities, but others decided to take their chances and run blind.

Their luck apparently held since there were no signs of accidents on the road.

A highway department truck was dispatched shortly after the rains began in earnest and by the time the downpour had reduced to a drizzle, the rocks were almost completely cleared away.

This morning, restaurants were serving a special on demand only, "boiled water."

And all because of .24 . . . that's right, 24 hundredths . . . of an inch of rain."